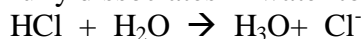


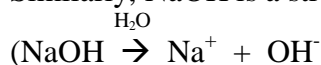
ANSWERS: Relate concentration to pH and conductivity

1) The pH of a solution depends on the concentration of H_3O^+ ions in solution. HCl is a strong acid, so it fully dissociates in water to form H_3O^+ ions and Cl^- ions.



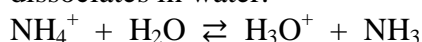
Therefore $[\text{H}_3\text{O}^+] = [\text{HCl}]$ so the pH is very low (1.0)

Similarly, NaOH is a strong base which fully dissociates in water

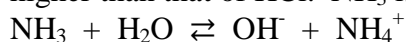


so $[\text{OH}^-] > [\text{H}_3\text{O}^+]$ and it has a high pH of 13.0

NH_4Cl firstly separates into NH_4^+ and Cl^- ions when it dissolves and NH_4^+ is a weak base which partially dissociates in water.

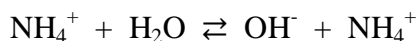


Therefore as the $[\text{H}_3\text{O}^+]$ is increased the pH is below 7, but only very little NH_4^+ dissociates so the pH is higher than that of HCl . NH_3 is a weak base which also partially dissociates in water



So the concentration of OH^- ions in solution is increased so the pH is above 7 but as NH_3 only partially dissociates the pH is lower than that of NaOH .

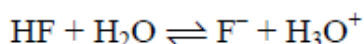
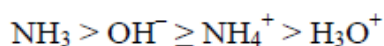
The conductivity of a solution depends on the concentration of charged particles (ions) in solution which can carry the flow of charge. HCl , NH_4Cl and NaOH all completely separate into cations and anions when they are dissolved in water, so the solutions have a high concentration of ions which carry a current so that all have high conductivity. In a solution of NH_3 , however, the only ions present are those formed from the dissociation of the base into OH^- and NH_4^+ ions and as NH_3 is a weak base only very little dissociates. Therefore the concentration of ions in aqueous solution is lower so it has low conductivity.



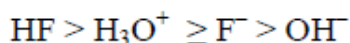
2)



Equilibrium is to the left, so the greatest concentration of a species is NH_3 . For each NH_3 that reacts equal amounts of NH_4^+ and OH^- are formed and are greater than the OH^- and H_3O^+ formed by the dissociation of water.



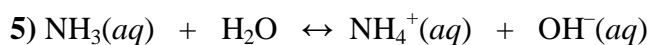
Equilibrium is to the left, so the greatest concentration of a species is HF . For each HF that reacts equal amounts of F^- and H_3O^+ are formed and are greater than the OH^- and H_3O^+ formed by the dissociation of water.



3) pK_a of methanoic acid is smaller so it is a stronger acid (more acid is dissociated) and therefore higher $[H_3O^+]$. High $[H_3O^+]$ = low pH

4) CH_3NH_2 is a weak base and only reacts slightly with water / it is a weak base, equilibrium lies to the left/only partial dissociation.

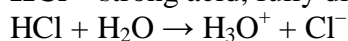
As most aminomethane remains in the molecular state there are few ions in the solution, making it a weak electrolyte.



As NH_4Cl dissolves $[NH_4^+]$ is increased. This causes the equilibrium to move to favour formation of reactants so that $[OH^-]$ is decreased. As $[OH^-]$ is decreased, $[H_3O^+]$ is increased and pH is decreased.

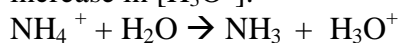
6) HCl , NH_4Cl , $NaCl$, NH_3 , $NaOH$

HCl – strong acid, fully dissociates giving high concentration of H_3O^+ .



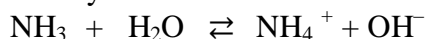
NH_4Cl dissolves to give a solution of

NH_4^+ and Cl^- ions. The NH_4^+ ions are weakly acidic and partially dissociate in water to give a small increase in $[H_3O^+]$.

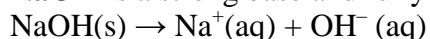


NaCl dissolves to give Na^+ and Cl^- ions, but neither of these have any reaction with water so solution is neutral.

NH_3 is a weak base and reacts with water to give a small increase in the conc of OH^- , making the solution weakly alkaline.



NaOH is a strong base and fully dissociates, giving a high concentration of OH^- ions.



7) Statement is incorrect – it should be that 8 mol L^{-1} acid is more concentrated than 0.02 mol L^{-1} .

or

one acid is stronger than another if it dissociates into ions (H_3O^+ and A^-) more readily.

or

similar correct statement.

8) K_a for CCl_3COOH ($10^{-0.70}$) is $>$ K_a for CH_3COOH ($10^{-4.75}$)

So the numerator of the K_a expression is larger and $[H_3O^+]$ is therefore higher so the CCl_3COOH is the stronger of the two acids.